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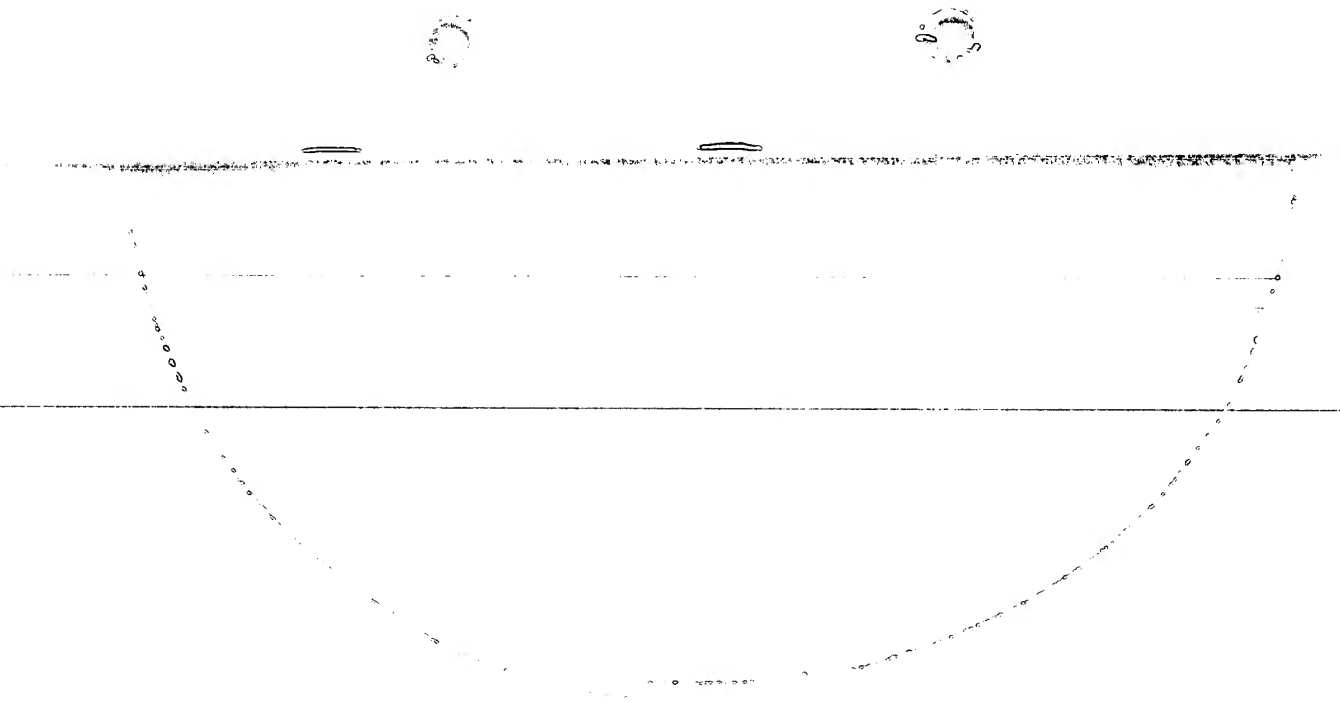

DRAWINGS
17 Sheets

Applicant: Michael J. Renn
Serial No. 10/072,605
Filing Date: February 5, 2002
For: *Direct Write™ System*

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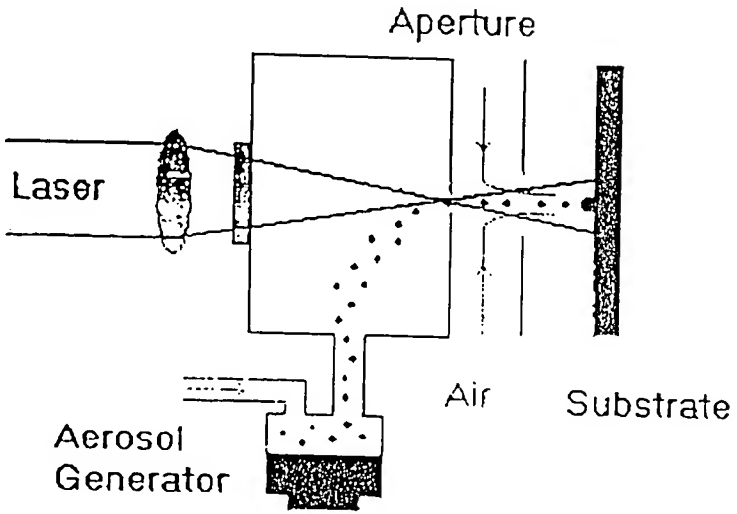


Fig. 1.

Features

- *High Velocity (~10m/s)*
- *Variable Beam Diameter (10 μm)*
- *High Throughput (~ 10^9 s^{-1} in 100μm beam)*
- *Reduced Clogging*
- *Long Working Distance (~ few cm)*
- *Simultaneous Laser Treatment*

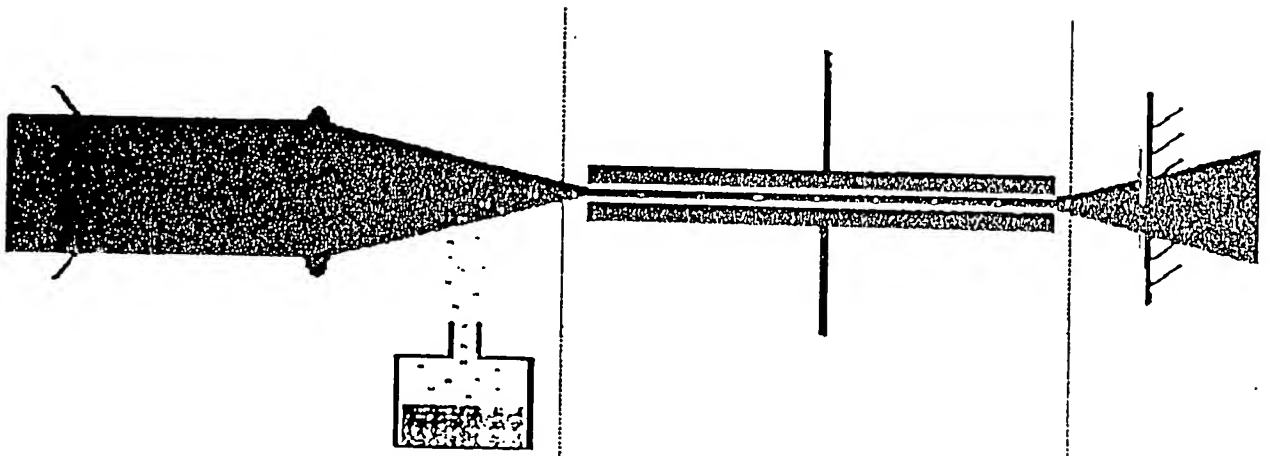


Fig. 2.

Aerosol Generation	Particle Delivery	Laser Processing
Features		
• Small droplets (~1 μm) • Dense aerosols (~10^{16} m^3)	• Accuracy to 3 μm • Single particle to 10^9 particles/s • Throughput to 0.25 mm^3/s	• Low power (~ 50 mW) • High scan rate (~1 m/s) • Dense, conductive materials (ρ~2x bulk)

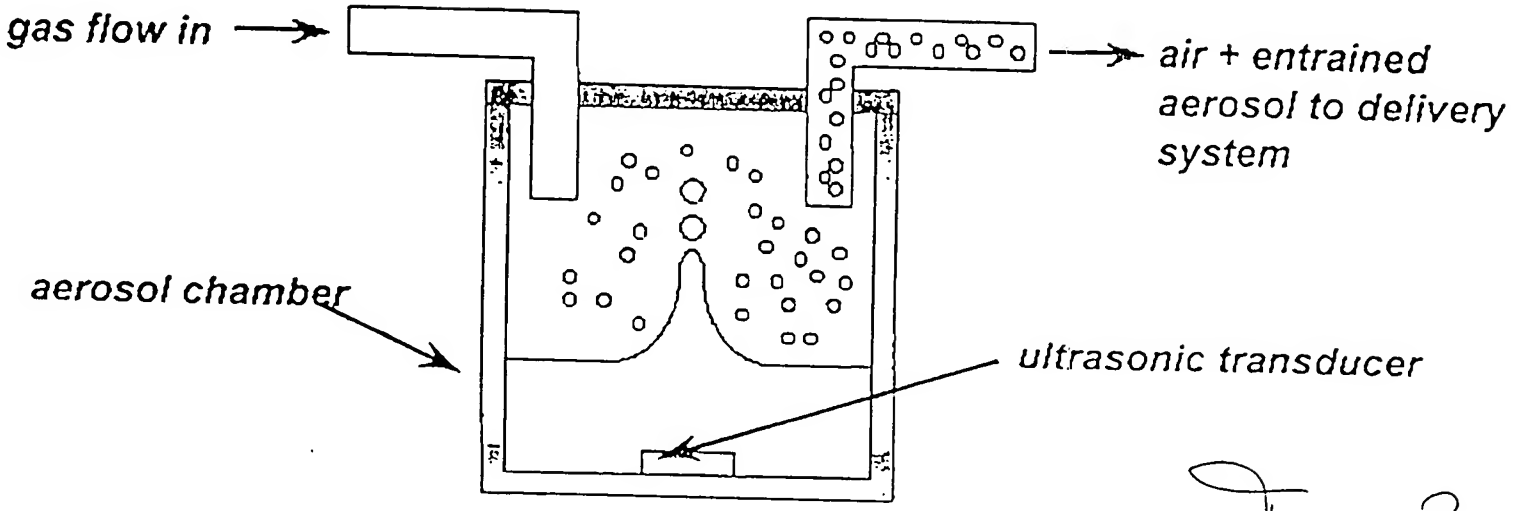
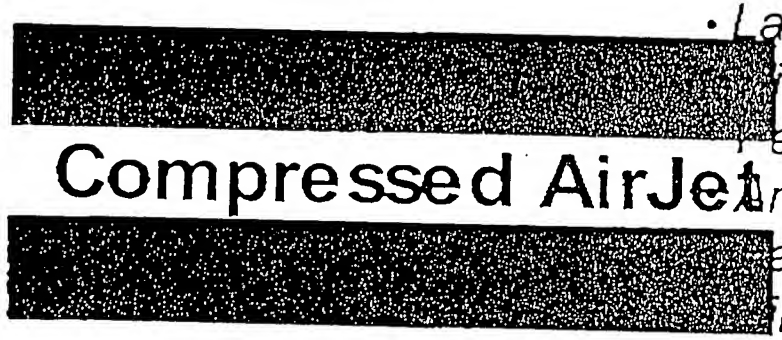


Fig. 3.

- *Small droplets (~1 μm, 1 fL)*
- *Dense aerosols (~10 ^{16} m^3)*
- *100 μL minimum sample*
- *All solids, all precursors, or solid/precursor mixtures*
- *Precursor based alloys with atomic scale mixing*
- *Organic and biological entities in droplets (enzymes, proteins, virus, etc.)*

Fig. 4.

Air Jet



- Large Particles (1-30 μm)
- igh Viscosity Fluids
- articles + Precursor binder
- nimal Cells + Media
- acteria
- rus

Particulate in Suspension

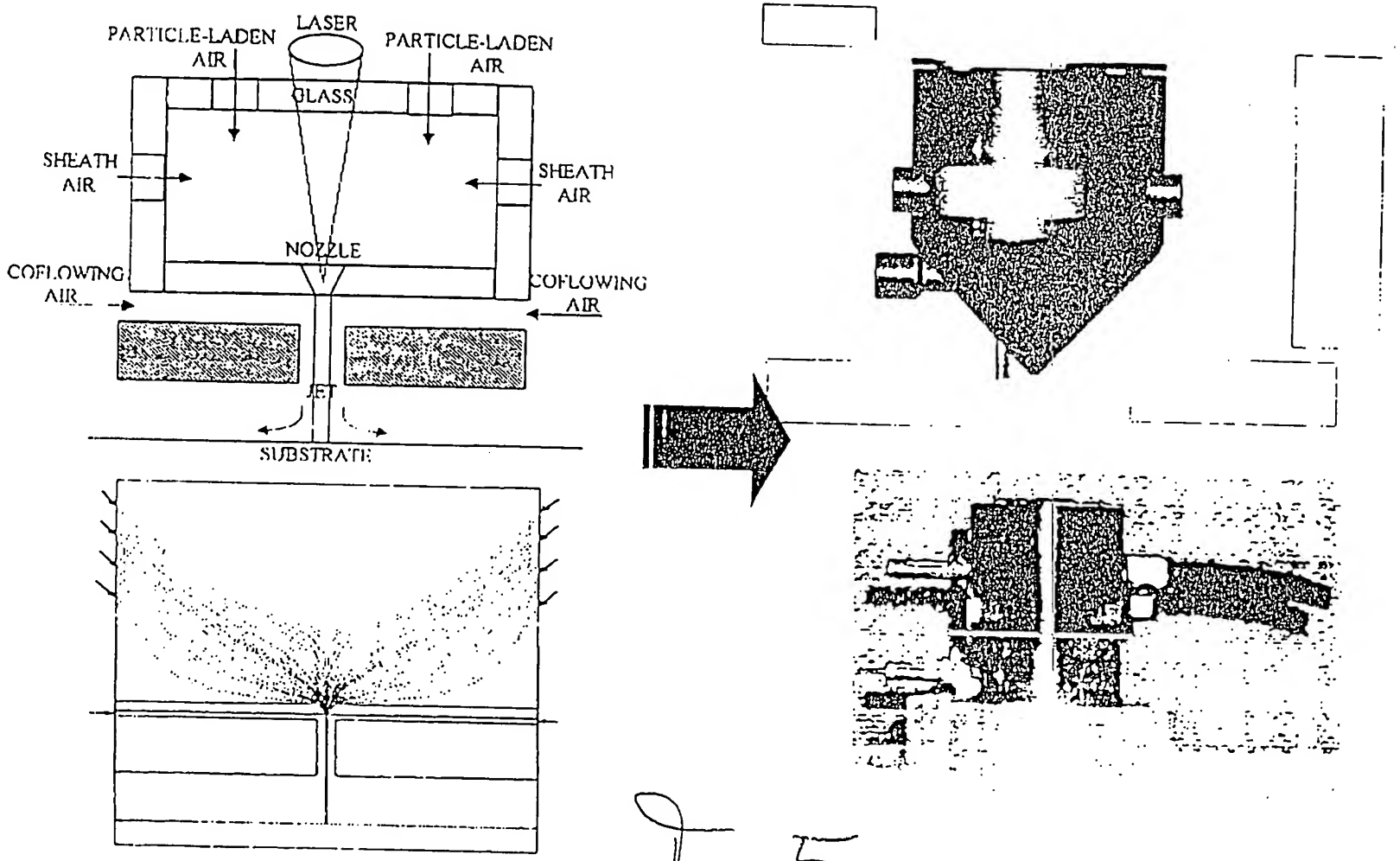

PARTICLE-LADEN AIR
LASER
PARTICLE-LADEN AIR
GLASS
SHEATH AIR
SHEATH AIR
NOZZLE
COFLOWING AIR
COFLOWING AIR
JET
SUBSTRATE

Fig. 5.

Cascade Impaction

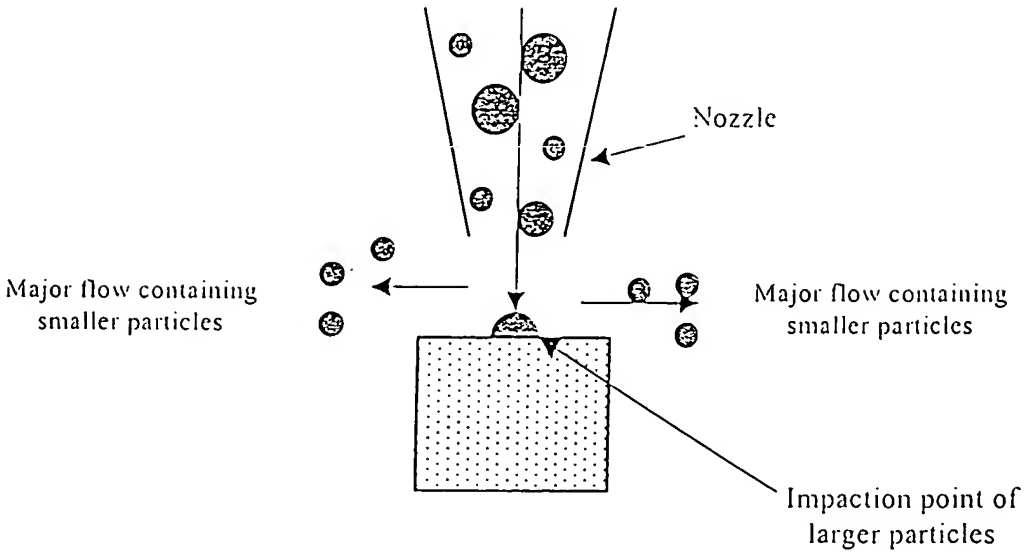


Fig. 6.

Virtual Impactor

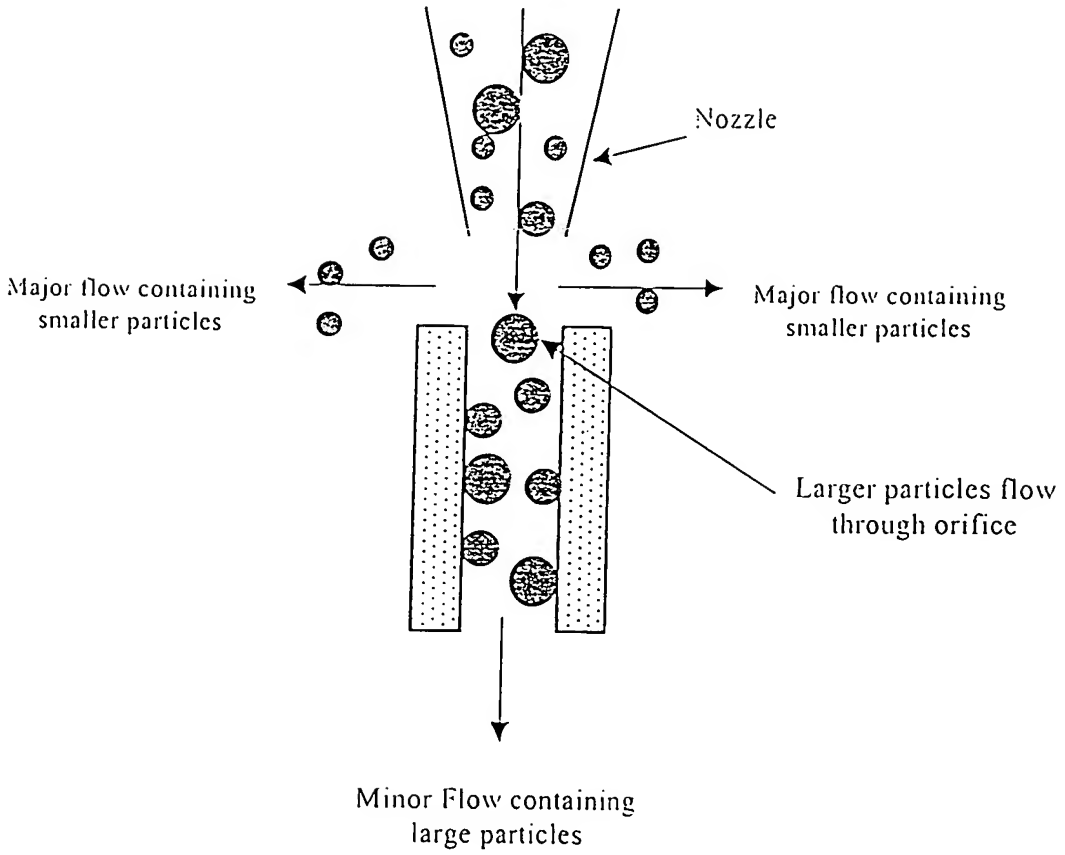


Fig. 7.

Virtual Impactors in Series

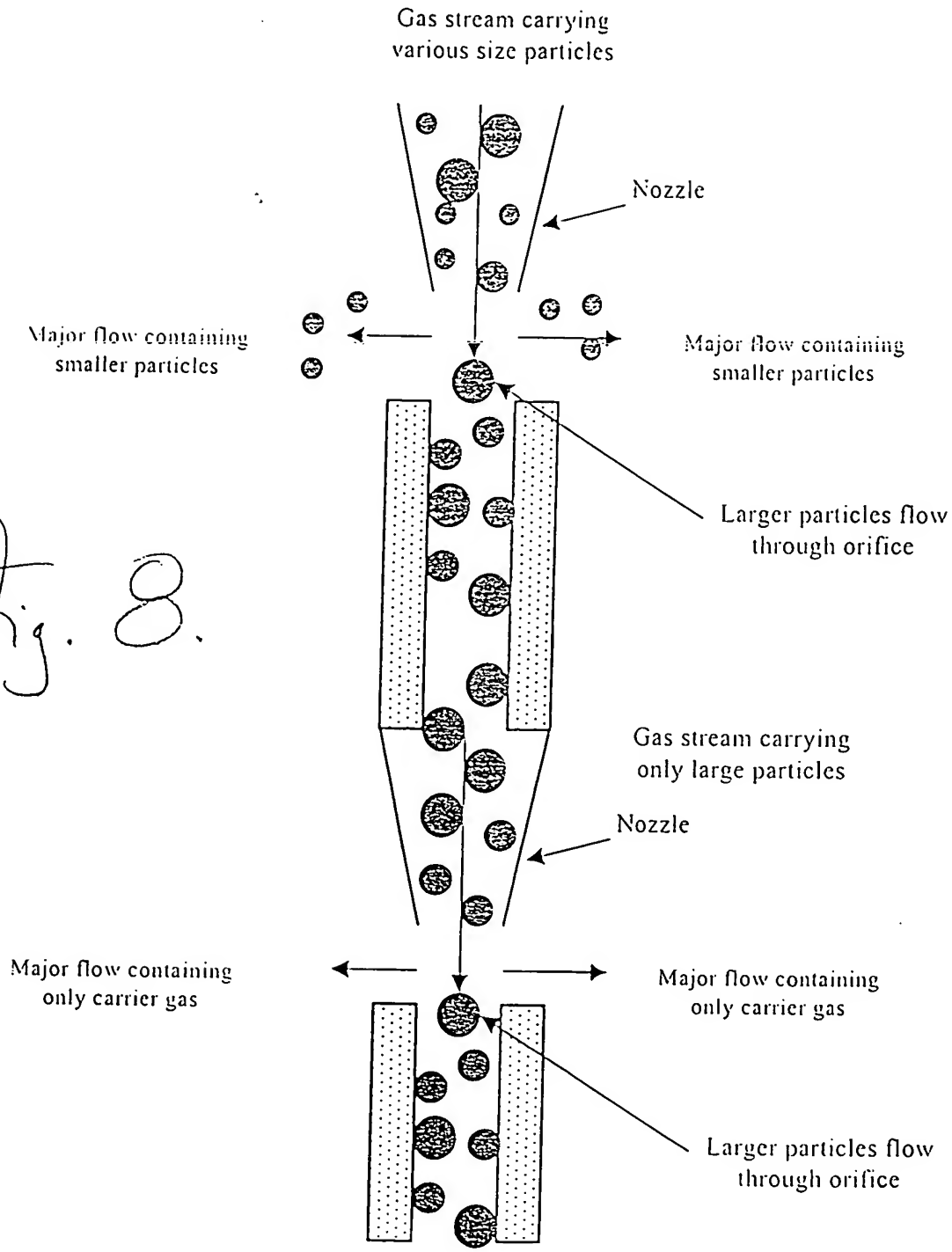


Fig. 8.

Particle Sorting at Atomization Unit
& Virtual Impactors in Series

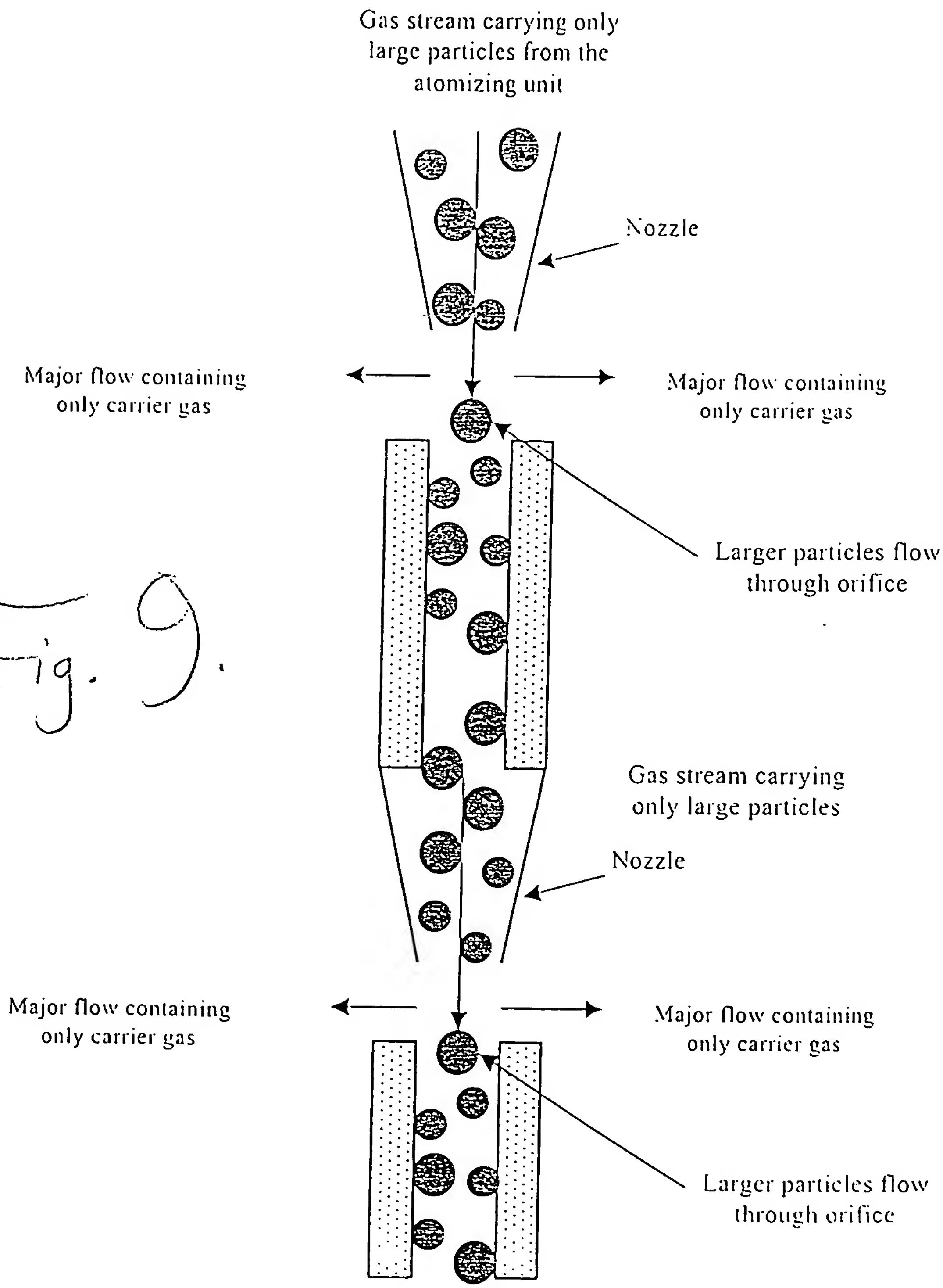
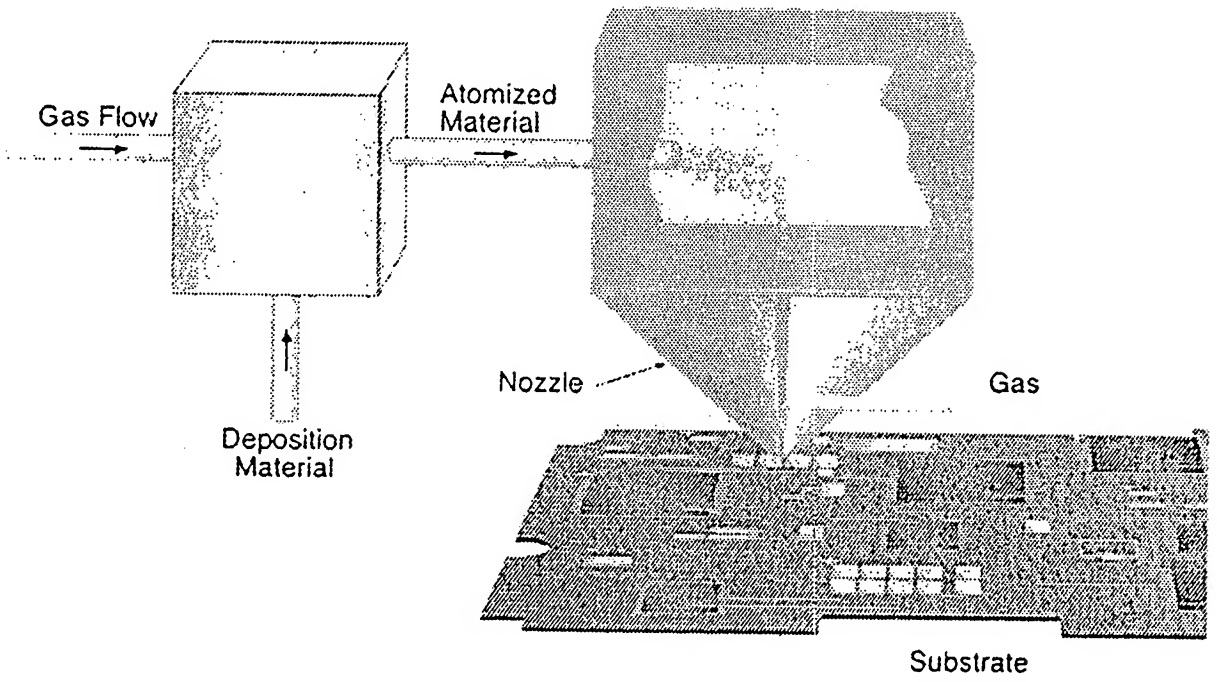


Fig. 9.

Fig. 10.

Flow Guidance Delivery System



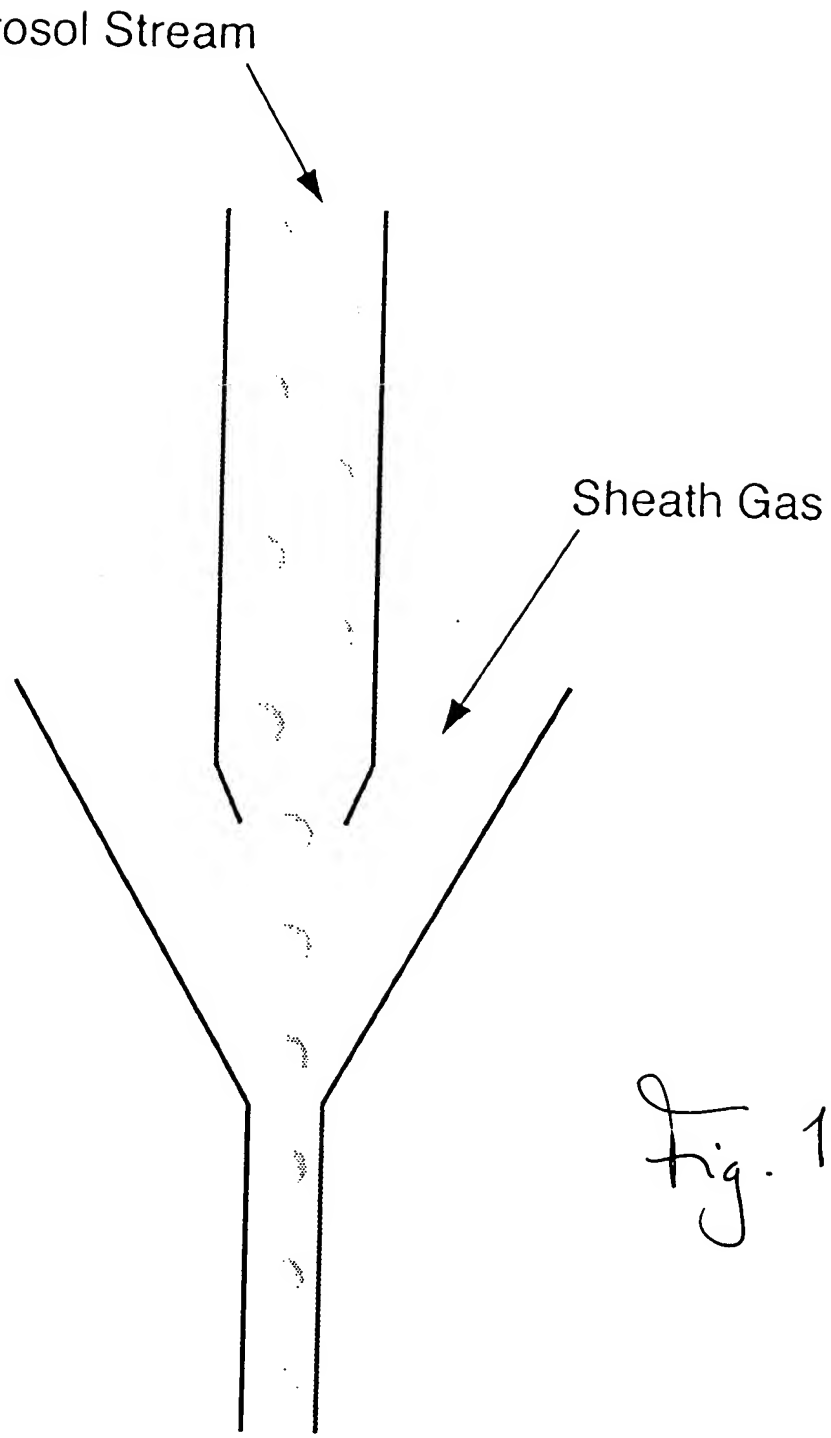
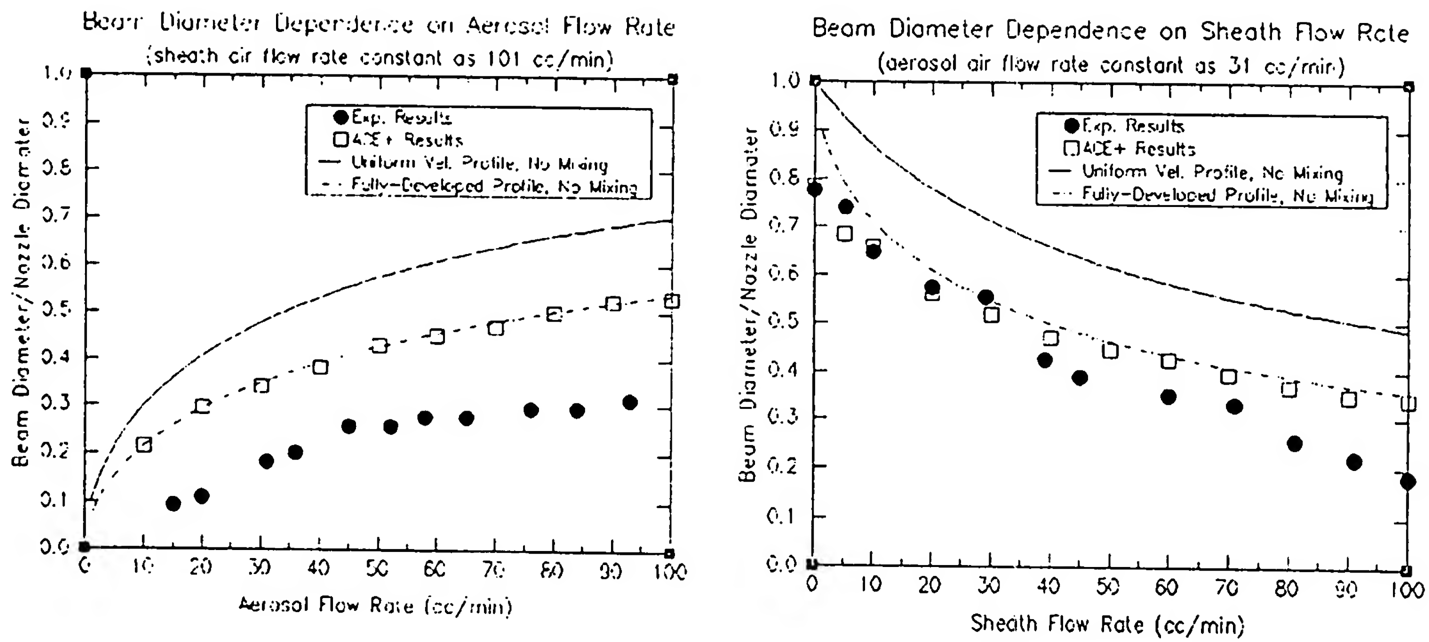


Fig. 11.

Fig. 12.



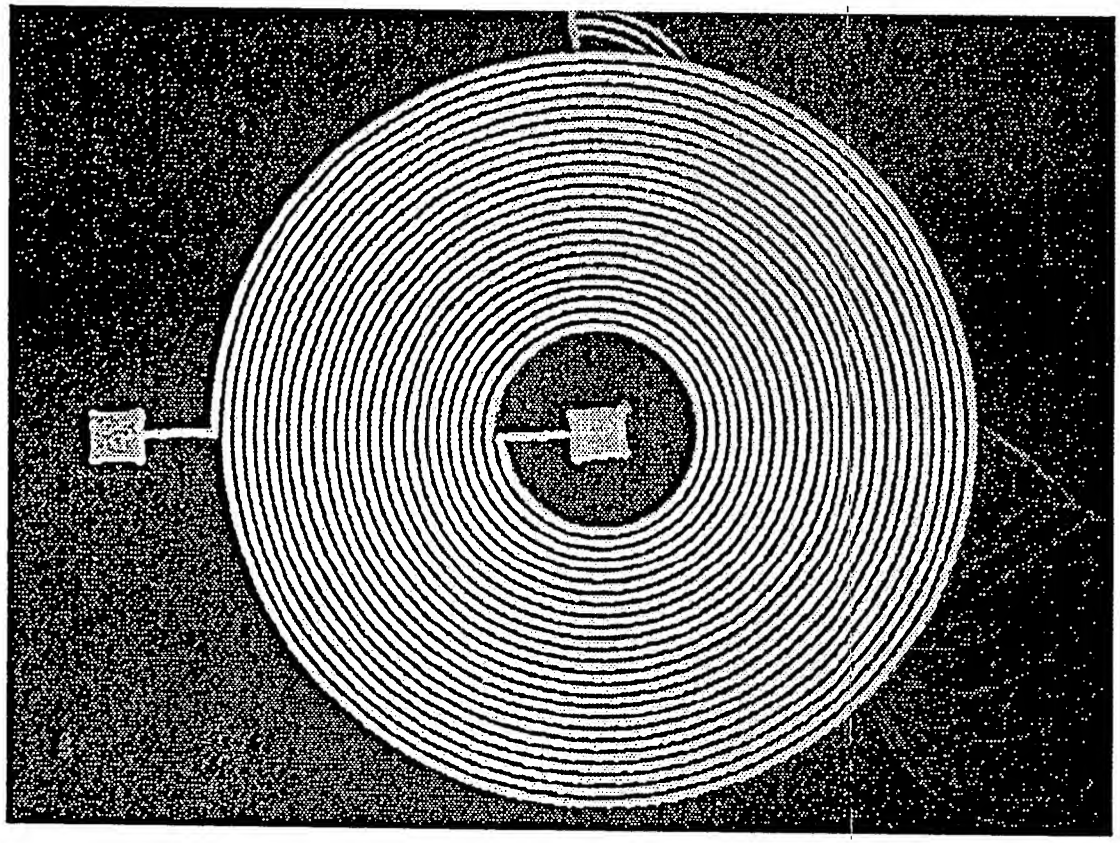


Fig. 13.

Fig. 14.

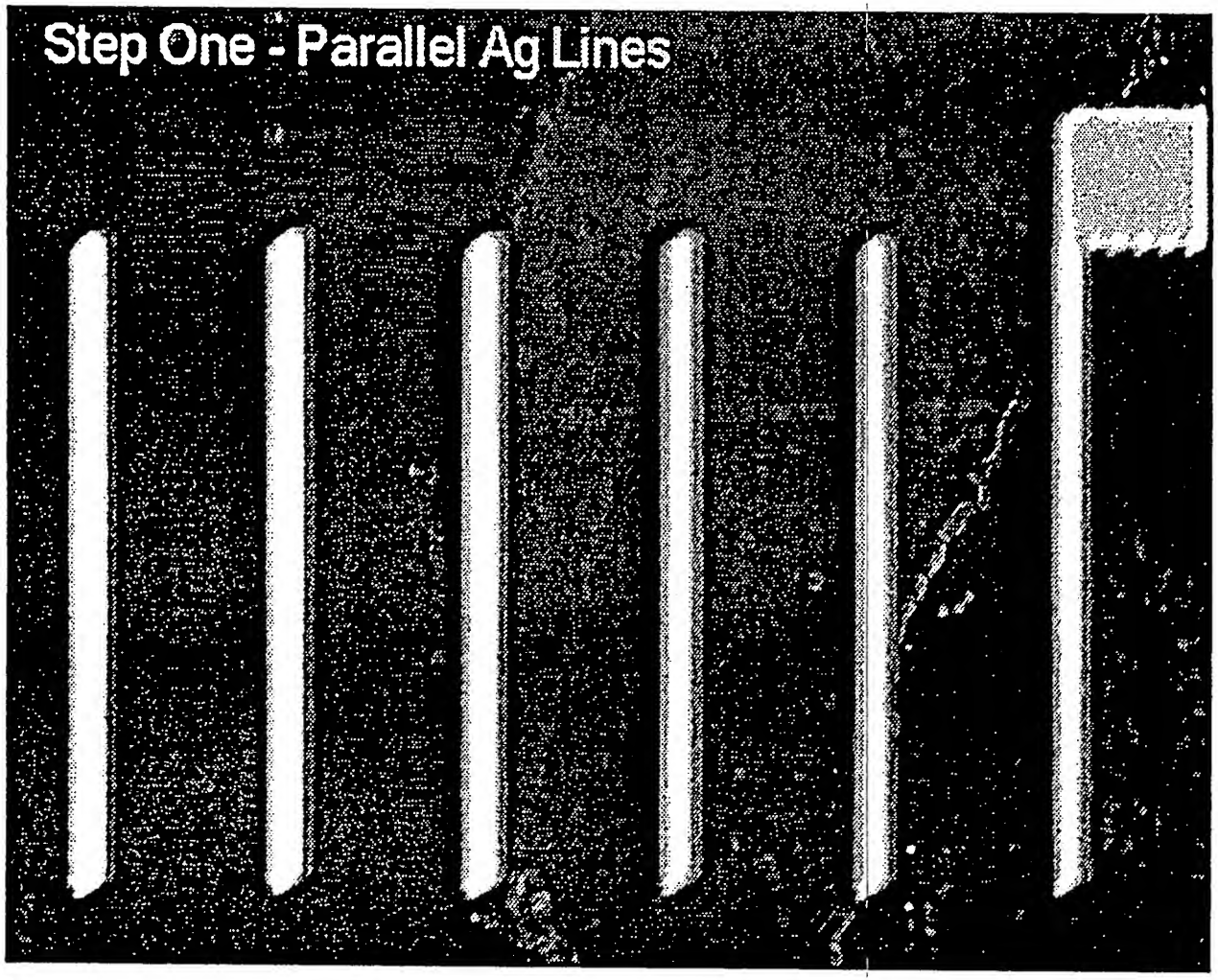


Fig. 15.

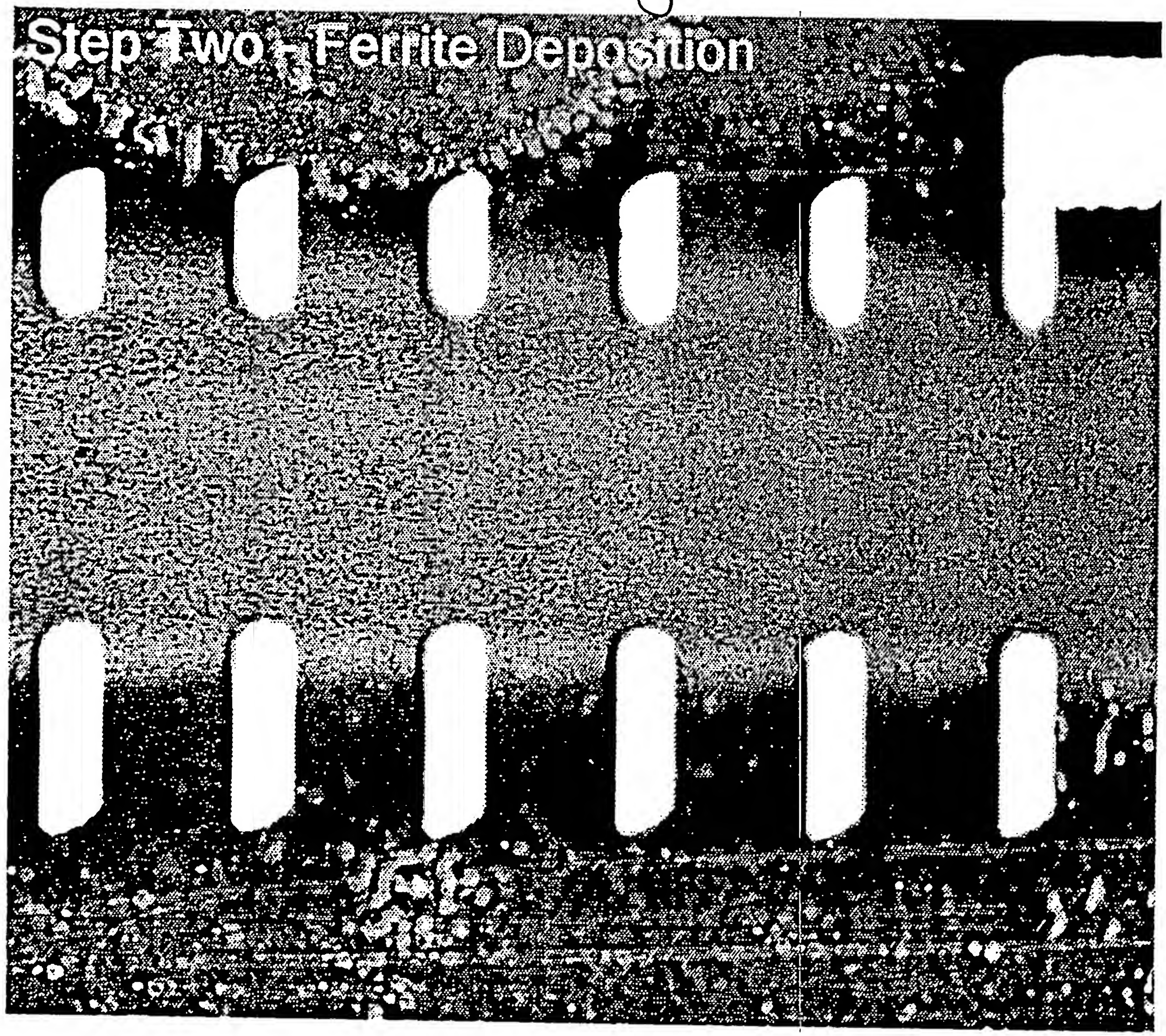
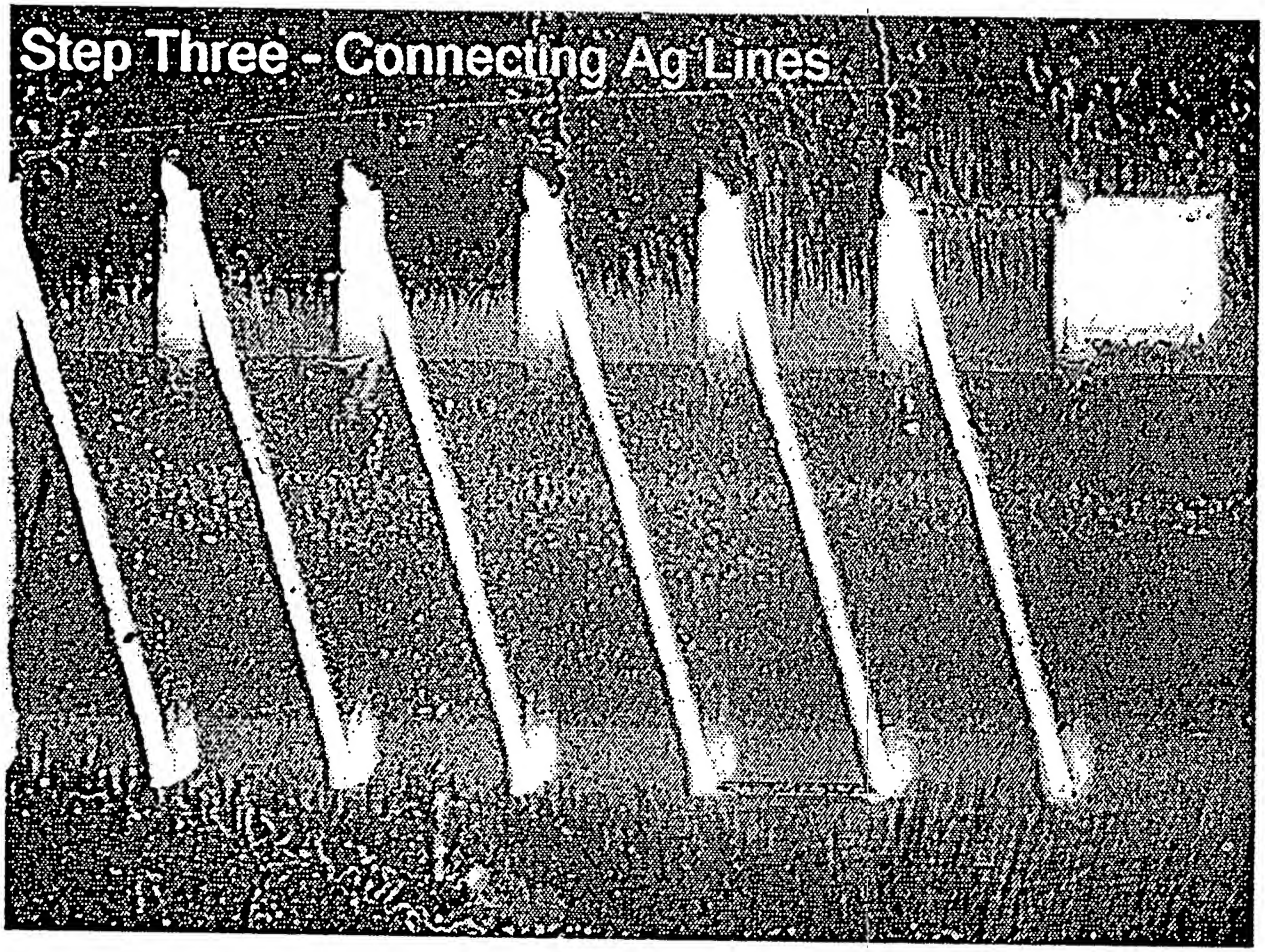


Fig. 16.



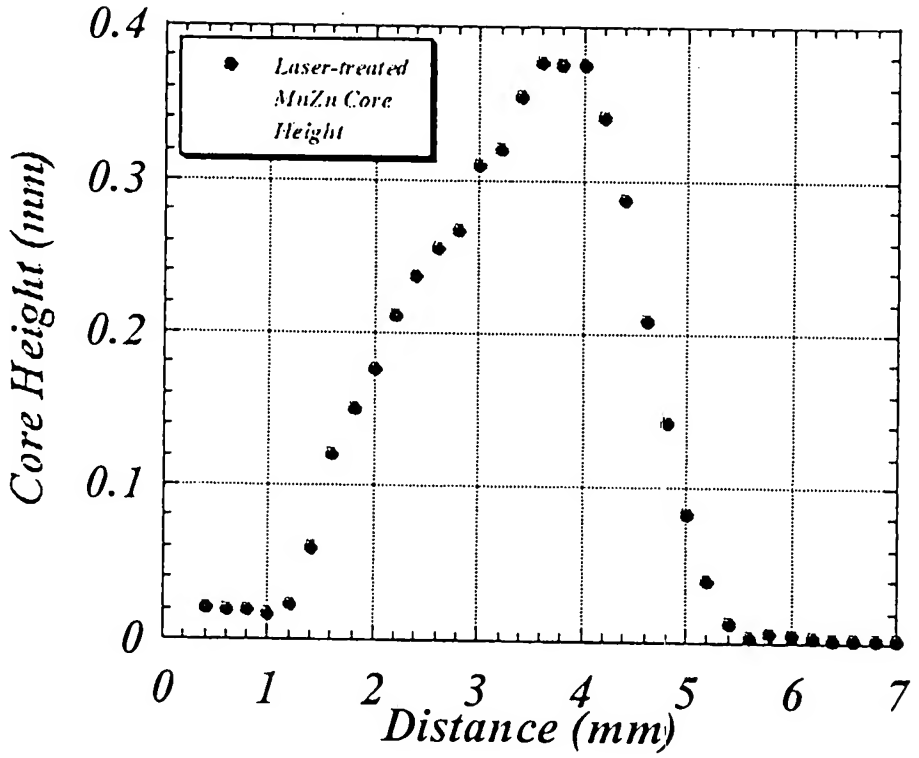


Fig. 17